Created on 2/15/2002 5:49 PM
Last modified on 2/27/02 by J. Yu

Specifications for DØ Regional Analysis Centers

, I. Bertram, F. Flithut, L. Lueking, P. Mattig, M. Narain, , B. Thooris, , J. Yu, C. Zeintz

Abstract

The expected data size at the end of RunIIa is over 400TB for raw data only. This immense amount data poses issues for sharing data for expeditious data analyses. In addition, the international character of the DØ experiment demands the data to be distributed throughout the collaboration. The data must be stored permanently and be reprocessed throughout the distributed environment. In this regard, it is necessary to construct regional analysis centers that can store large data set and can process data should there be any need for reprocessing. This document presents the specifications for such regional centers including data characteristics, requirement for computing infrastructure, and services that these centers must provide. This document also presents recommended sites to be established as regional analysis centers.

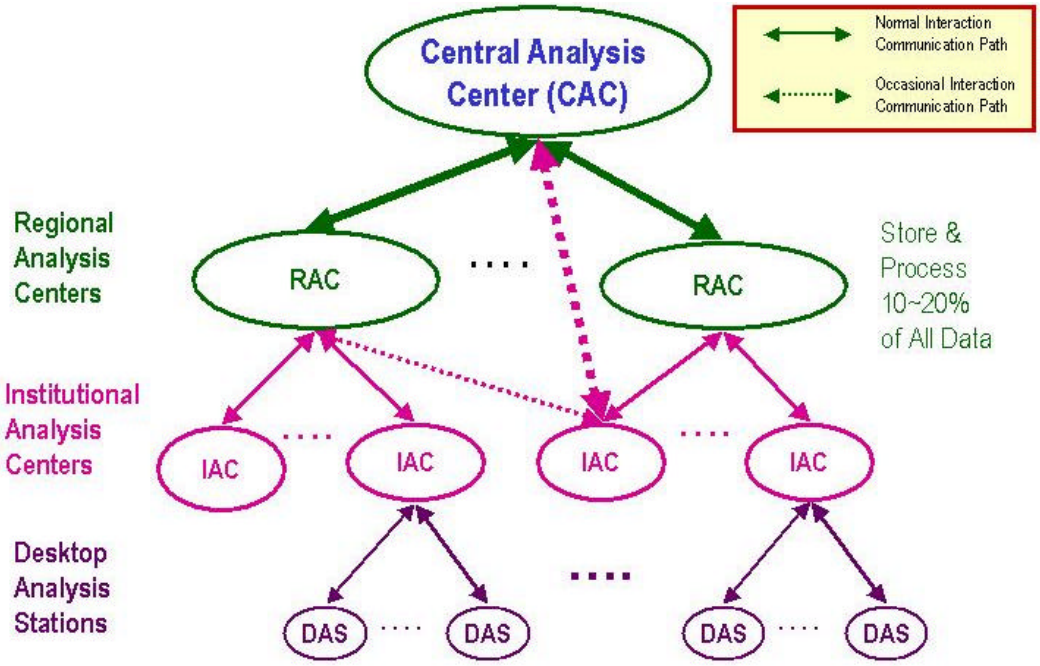
1. **Introduction**

   The current size of a typical event from the DØ detector is 0.25Mega Bytes (MB). The maximum output rate out of the online DAQ system is 50Hz in Run IIa. This rate and the size of the typical events constitutes 12.5MB/sec throughput. In addition the total number of events with the maximum output rate will results in 1.4×10^9 events at the end of the expected Run IIa. The fully optimized speed of reconstruction is expected to be 10sec/event. This results in 1.4×10^{10} seconds to complete a reconstruction cycle. This means it takes one full year to process the entire events using 500 computers, the expected number of offline reconstruction farm.

   Moreover the 400TB of resulting data set will take one to two months through a dedicated gigabit network to a single site. This means it would be just inconceivable and impractical to transfer data to all 77 collaborating institutions and over 600 physicists to access the data for analyses. This issues gets worse as the Tevatron delivers luminosity at its expected rate, resulting in a factor of eight or higher data size at the end of the entire Run II program.

   Given these issues related to immense amount of data, despite the fact that the centralize clusters of computers can provide a lot of services, it must be complemented with a model that allows distributed data model and capability for remote analysis from the central location, that is Fermilab.

   In addition one of the important tasks that remote institutions can contribute significantly is through software and analysis activities that do not require presence at the site of the experiment.
2. **Motivation for Regional Analysis Centers**
3. **DØ Remote Analysis Model (DØRAM) Architecture**



4. **Services Provided by the Regional Analysis centers**
    a. **Code Distribution Services**
    b. **Batch Processing Services**
    c. **Data Delivery Services**
    d. **Data Reprocessing Services**
    e. **Database access services**
5. **Data Characteristics**
    a. **Raw data**

    Some significant fraction of raw data must be transferred to these sites and permanently stored in their cache system for reprocessing.

    b. **Thumbnail**

    The thumbnail that constitutes to full data set statistics must be kept at these sites. These thumbnail data should be sufficient to provide significant data set for higher statistics refinement of analyses.

    c. **Specific Data Streams**
    d. **Data Replication**
6. **Requirements of Regional Analysis Centers**
    a. **Location Issues**
    b. **Network Bandwidths**
    c. **Storage Cache Size**
    d. **Computer Processing Infrastructure**

    The RACs must have sufficient computing processing power to reprocess all its data within four to six weeks. If an RAC keeps 10% of the data set in addition to Thumbnail data set, it requires ###TB of storage space.
7. **Recommended Sites and Justification**
    a. **Europe**
        i. **Karlsruhe**
        ii. **NIKHEF**
        iii. **IN2P3, Lyon**

iv. **Other Institutions**

b. **US**
   i. **University of Texas at Arlington**
   ii. **Boston University**
   iii. **Fermilab**
   iv. **Two more sites??**

c. **South America**
   i. **Brazil**

d. **Asia**
   i. **India**
   ii. **Korea**

8. Implementation Time Scale

In order for the RACs to be effective, gradual implementation with full capacity for Run IIa data set by the end of Run IIa. The infrastructure and capacity of the RACs must be scalable to grow together with the increase in data size.

9. Conclusions